DRAINAGE SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Not Applicable

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable

BACKGROUND OF THE INVENTION

(1) Field of the Invention

[0003] The present invention relates to a drainage system having vents to allow for equalization of the pressure in the system. In particular, the drainage system of the present invention has relief vents to allow gases to escape the system to reduce positive pressure in the drainage system. In one (1) embodiment, the drainage system may also have air valves to allow gases to enter the system to eliminate negative pressure.

(2) Description of the Related Art

[0004] In the past, one (1) of the problems associated with multi-story drainage systems was the creation of positive pressure or back pressure in the branch piping. The positive pressure occurred when gases were trapped in the branch piping. Excessive amounts of gas trapped in the branch piping can blow water out of the traps of the fixtures connected to the branch piping. In one (1) instance, the positive pressure is caused by an overload of waste in the stack. Positive pressure can also be caused when waste moves down the stack at an excessive speed, thus trapping the gases in the branch piping. In multi-story buildings, the flow of waste from upper stories accelerates as it moves down the stack due to gravity. Thus, the higher the entrance point of waste into the stack, the greater the speed attained by the waste and the greater the likelihood that positive pressure will be created in the lower branch pipings. Systems other than multi-story systems may also have a problem with positive pressure. Caused when waste is introduced into the stack at a high rate of flow. One such instance is where the system includes a washing machine having

a high velocity pump to drain the water.

[0005] In the past, drainage systems for multi-story buildings greater than five (5) stories contained a vertical vent pipe connected to a vertical waste or soil stack with branch piping for the various floors extending off the waste or soil stack. In these systems, the vent pipe is connected between the bottom of the waste or soil stack and the top of the waste or soil stack. In some instances, the drainage system included both a waste stack and a soil stack connected to the vent pipe and the branch piping. The vent pipe allowed gases to escape from the waste or soil stack into the vent stack and through the top of the vent stack to the outside air. For such a system to operate correctly, the vent pipe must be a minimum of half the size of the waste or soil stack. Thus, additional space is needed for the vent pipe. In addition, it is difficult to retrofit a drainage system with a vent pipe.

[0006] U.S. Patent No. 4,121,914 to Kigawa et al. describes one device for eliminating the need for a separate vent pipe. Kigawa et al. describes a drainage piping system which uses a twisted pipe having an axis helically deviating from the axis of the main pipe. The twisted pipe causes the waste to flow through the main pipe in the form of a helically swirling descending stream. The twisted pipe reduces the vertical velocity of the descending stream and also causes the stream to flow down the inner surface of the pipe. The twisted pipe ensures that the stream flowing down the vertical main pipe will have an air column extending therethrough in the center of its cross-section to allow gases to move past the stream.

[0007] The drainage system of the present invention relieves positive pressure in the branch piping of a drainage system without the need for a separate vent pipe. There remains the need for a drainage system which is easy to install and which eliminates build up of positive pressure in the branch piping of the drainage system.

SUMMARY OF THE INVENTION

[0008] The drainage system of the present invention eliminates positive pressure in the branch piping of the

drainage system which eliminates the possibility of water being blown from traps through the fixtures attached to the branch piping. One (1) embodiment of the drainage system also relieves negative pressure in the branch piping. Negative pressure in a drainage system can drain the liquid out of the traps for the fixtures connected to the branch piping rendering the traps ineffective in stopping the escape of sewer gases through the fixtures. The positive pressure in the drainage system of the present invention can be caused by waste moving at a high rate of speed down the stack. Such a high rate of speed is achieved in the system where the stack of the system has a height of at least 480 feet (12191mm) between the entrance of the waste and the main drain of the system. The high rate of speed is also acheived where the waste is introduced into the system at a high rate of speed such as by a high velocity drainage pump. The connection of the stack at a 90° angle to the main drain also helps to trap gases in the stack.

[0009] The drainage system of the present invention includes a stack, a branch piping and a relief vent. The drainage system can also include an air admittance value to eliminate negative pressure in the drainage system. A fixture with a trap is connected to the branch piping. The relief vent is connected to the branch piping between the stack and the trap of the fixture such that the inner passageway of the relief vent is in fluid communication with the inner passageway of the branch piping. If the branch piping has more than one fixture, then the relief vent is connected to the branch piping between the stack and the first trap, closest to the stack. The relief vent is a unidirectional vent which opens automatically upon the application of positive pressure at the first end of the passageway of the flexible vent member. The relief vent closes automatically when the pressure is reduced. In one (1) embodiment, the relief vent closes automatically when the pressure at the first end of the passageway is less than or equal to atmospheric pressure. In one (1) embodiment, the relief vent includes an elastomeric, flexible vent member

which uncurls and separates to form the passageway to allow the trapped gas to escape the branch piping. The flexible vent member is positioned within a cover having a body and a cap. The sidewall of the cover has openings to allow the gas escaping the branching piping thru the flexible vent member to exit the cover into the surrounding air. The relief vent is mounted at a high point on the branch piping to allow the drains of fixtures to back up into the fixtures during a blockage rather than attempting to exit the drainage system thru the relief vent. The relief vent is connected to the branch piping by a connector. In the drainage system also having the air admittance valve, the relief vent and the air admittance valve can be connected to the branch piping at the same point using a Y-connector. The air admittance valve is in fluid communication with the branch piping and is connected to the branch piping before the trap of the first fixture. The air admittance valve is structionally similar and operates similarly to air admittance valve well know in the art. The air admittance valve opens upon the application of negative pressure at the first end of the inner passageway connected to the branch piping. The air admittance valve opens to allow air to enter the air admittance valve and the drainage system. The air admittance valve closes automatically once the pressure in the branch piping adjacent the first end of the air admittance valve is greater than or equal to the atmospheric pressure.

[0010] The present invention relates to a drainage system, which comprises a stack having an inlet and an outlet; a branch pipe connected to the stack at a point spaced between the inlet and the outlet of the stack having a drain opening with a vent opening spaced between the stack and the drain opening; and a relief vent connected to the branch pipe at the vent opening in fluid communication with the branch pipe wherein when gas enters the inlet of the stack and create positive pressure in the branch pipe, the relief vent opens to allow gas in the branch pipe to escape so as to equalize pressure in the drainage system.

[0011] Further, the present invention relates to a drainage

system, which comprises a stack having an inlet and an outlet; a branch pipe in fluid communication with the stack and connected to the stack between the inlet and the outlet of the stack, the branch pipe having a drain opening; a relief vent in fluid communication with the branch pipe and connected to the branch pipe between the drain opening and the stack and configured to open in response to positive pressure in the branch pipe to equalize pressure in the branch pipe; and an air admittance valve in fluid communication with the branch pipe and connected to the branch pipe between the drain opening and the stack and configured to open in response to negative pressure in the branch pipe to equalize pressure in the branch pipe.

[0012] Still further, the present invention relates to a method for equalizing pressure in a drainage system, the drainage system having a stack having an inlet and an outlet with a branch pipe in fluid communication with the stack connected to the stack between the inlet and the outlet, the branch pipe having a drain opening, the method which comprises the steps of: providing a relief vent connected to the branch pipe at a point spaced between the stack and the drain opening; providing fluid into the inlet of the stack so that the fluid moves past the branch pipe and moves into the branch pipe; opening the relief vent in response to positive pressure in the branch pipe adjacent the relief vent; and evacuating gas in the branch pipe through the relief vent until pressure in the pipe valve is equalized.

[0013] The substance and advantages of the present invention will become increasingly apparent by reference to the following drawings and the description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Figure 1 is a schematic view of the drainage system 10 showing the relief vent 16, the air admittance valve 30, the branch piping 14 and the stack 12.

[0015] Figure 2 is a cross-sectional view of the relief vent 16 with the flexible vent member 20 in the closed position.

[0016] Figure 3 is a cross-sectional view of the relief vent 16 with the flexible vent member 20 in the open position.

[0017] Figure 4 is a prior art drainage system having positive pressure.

[0018] Figure 5 is a prior art drainage system having negative pressure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0019] The drainage system 10 of the present invention includes a stack 12, branch piping 14, a relief vent 16 and optionally an air admittance valve 30. The stack 12 has opposed ends and is connected at the second or bottom end to the main drain 100 (Figure 1). In one (1) embodiment, the stack 12 is connected to the main drain 100 at a 90° angle. The stack 12 can be a waste stack 12 or a soil or sewer stack (not shown). In one (1) embodiment, the system 10 includes both a waste stack 12 and a soil stack. The branch pipings 14 (one shown) are connected to the stack 12 between the ends of the stack 12. In one (1) embodiment, where the drainage system 10 is incorporated into a multi-story structure, each floor of the structure is provided with a branch piping 14. Each branch piping 14 has at least one fixture 102 connected thereto. The fixtures 102 can be bathroom or kitchen fixtures such as sinks, bathtubs, toilets, etc. A trap 104 is provided between the branch piping 14 and each one of the fixtures 102 to prevent sewer gases from escaping from the drainage system 10 then the fixture 102.

[0020] The relief vent 16 is connected to the branch piping 14 between the stack 12 and the trap 104 of the fixture 102. In one (1) embodiment, the relief vent 16 is similar in structure to the valve described in applicant's U.S. Application Serial No. 10/245,126, which is incorporated herein by reference in its entirety. However, it is understood that the relief vent 16 can be any type of one-directional valve well known in the art which opens upon the application of pressure at one (1) end and which automatically closes upon a decrease in pressure. The relief vent 16, of one (1)

embodiment, includes a collar 18, a flexible vent member 20 and a cover 22. The collar 18 has a first end 18A and a second end 18B with an inner passageway 18C extending between the ends 18A and 18B. The axis of the inner passageway 18C of the collar 18 forms the longitudinal axis A-A of the relief vent 16. In one (1) embodiment, the collar 18 has a cylindrical shape. The collar 18 has a first portion adjacent the first end 18A and a second portion adjacent the second end 18B. The inner and outer diameters of the first portion are greater than the inner and outer diameters of the second portion, respectively, such that a shoulder is formed in the inner passageway 18C and on the outer surface of the collar 18 between the first and second portions. The size of the inner passageway 18C of the collar 18 adjacent the first end 18A is such that the first end 18A of the collar 18 can be mounted over the end of a standard connector pipe 106 which is connected to the branch piping 14 (Figures 2 and 3). It is understood that the collar 18 could also be mounted inside of the standard connector pipe 106. The collar 18 can be mounted to the standard connector pipe 106 by any well known means.

[0021] The flexible vent member 20 is mounted on the second end 20B of the collar 18 and extends in a direction away from the first end of the collar 18 and away from the connector pipe 106. The flexible vent member 20 has a first end 20A and a second end 20B with an inner passageway 20C extending therebetween. The first end 20A of the flexible vent member 20 is mounted on the second portion of the collar 18 such that the second portion of the collar 18 is in the inner passageway 20C of the flexible vent member 20 and the inner passageway 20C of the flexible vent member 20 at the first end 20A is co-axial with the longitudinal axis A-A of the relief vent 16. The size of the flexible vent member 20 enables the first end 20A of the flexible vent member 20 to be stretched to mount over the second portion of the collar 18. The mounting of the flexible vent member 20 on the outer surface of the collar 18 ensures that the inner passageway 20C of the flexible vent member 20 is always open adjacent the first end 20A of the flexible vent

member 20. The flexible vent member 20 can be constructed of a durable, flexible resilient material having memory. In one (1) embodiment, the flexible vent member 20 is constructed of a specifically formulated elastomeric flexible PVC material such as SUNPRENE™ which will remain flat and which has memory. The first end 20A of the flexible vent member 20 can be mounted to the collar 18 by any well known means such as by friction fit or by use of an adhesive. In the normal position, the inner passageway 20C of the flexible vent member 20 adjacent the second end 20B is closed so that gases can not pass through the relief vent 16. In one (1) embodiment, the second end 20B of the flexible vent member 20 is curled away from the axis A-A of the relief vent 16 which acts to close the inner passageway 20C of the flexible vent member 20. In one (1) embodiment, the second end 20B of the flexible vent member 20 has a J-shape. In this embodiment, the flexible vent member 20 of the relied valve opens upon the application of pressure to the inner passageway 20C at the first end 20A of the flexible vent member 20. Upon removal of the pressure, the inner passageway 20C of the flexible vent member 20 at the second end 20B closes preventing the passage of gas through the relief vent 16.

[0022] The cover 22 is mounted on the second end 18B of the collar 18 over the first end 20A of the flexible vent member 20 so that the second end 20B of the flexible vent member 20 extends into the interior of the cover 22 (Figures 2 and 3). The cover 22 has a first end 22A and a second end 22B with a sidewall 22C extending therebetween. The length of the cover 22 between the ends 22A and 22B is such that when the flexible vent member 20 is in the fully open position, the second end 20B of the flexible vent member 20 does not contact the second end 22B of the cover 22. The inner diameter of the cover 22 adjacent the first end 22A is greater than the outer diameter of the second portion of the collar 18 with the flexible vent member 20 so that the cover 22 can be mounted over the second end 22B of the collar 22. The cover 22 extends outward from the second end 22B of the collar 18 away from the first end 18A of the collar 18. The cover 22 can be mounted over the collar

18 and flexible vent member 20 by any well known means. The sidewall 22C of the cover 22 is provided with openings 24 which allow gas exiting the flexible vent member 20 to be vented to the outside. In one (1) embodiment, the cover 22 is constructed of a body 26 and a cap 28. In this embodiment, the cap 28 is mounted on the open second end of the body 26. The cap 28 is removable to allow access to the flexible vent member 20.

[0023] In one (1) embodiment, the relief vent 16 has a compact construction so that the relief vent 16 can be easily positioned inside the cabinet of a fixture 102 or can be easily positioned adjacent a fixture 102 without being intrusive. The relief vent 16 is constructed of a durable material which is resistant to gases and liquids found in a drainage system 10. The relief vent 16 is constructed so as to be easily incorporated into any new or existing drainage system 10. The relief vent 16 allows gases to exit the branch piping 14 before the pressure of the trapped gases blow the water out of the traps 104 of the fixtures 102 connected to the branch piping 14. In one (1) embodiment, the relief vent 16 is constructed so that liquid cannot exit through the relief vent 16.

[0024] The relief vent 16 is connected to the branch piping 14 between the stack 12 and the trap 104 for the fixture 102 connected to the branch piping 14. If the branch piping 14 has more than one (1) fixture 102 having a trap 104, then the relief vent 16 is spaced between the stack 12 and the first trap 104. Thus, the relief vent 16 is connected downstream of all the fixtures 102 of the branch piping 14. In one (1) embodiment, the relief vent 16 is positioned at the highest point possible on the branch piping 14. In one (1) embodiment, the relief vent 16 is spaced so that in the fully extended open position, the second end 20B of the flexible vent member 20 is above the drain openings or normal water lines for all the fixtures 102 connected to the branch piping 14 (Figure 1). The positioning of the relief valve 16 above the drain openings or normal water lines allows for the user to determine when the drain of a fixture 102 is plugged due to a back up of liquid

into the fixture 102 or above the normal water line of the fixture 102.

[0025] In a first embodiment, the drainage system 10 is a multi-story drainage system 10 for a structure having at least five (5) stories. In one (1) embodiment, the drainage system 10 is a multi-story drainage system 10 having a stack 12 with a height of at least 40 feet (12192 mm). In one (1) embodiment, each branch piping 14 is provided with a relief vent 16. In another embodiment, only branch piping 14 at the fifth story and above are provided with a relief vent 16. In another embodiment, the drainage system 10 is in a structure having less than five (5) stories. In this embodiment, one of the fixtures 102 connected to one (1) of the branch pipings 14 of the drainage system 10 has a high velocity drainage pump. In this embodiment, all of the branch pipings 14 downstream from the fixture 102 or at a lower story from the fixture 102 are provided with a relief vent 16. In one (1) embodiment, the fixture 102 having the high velocity drainage pump is a washing machine.

[0026] In one (1) embodiment, the drainage system 10 also includes an air admittance valve 30 which enables air to enter the branch piping 14 to reduce the negative pressure in the drainage system 10. In one (1) embodiment, the air admittance valve 30 is similar to the air vent described in Applicant's U.S. Patent No. 6,161,564, which is incorporated herein by reference in its entirety. It is understood that the air admittance valve 30 of the present invention can be similar to any air admittance valve 30 well known in the art. In one (1) embodiment, the air admittance valve 30 is connected downstream from all the fixtures 102 of the drainage system 10. In one (1) embodiment, having both the relief vent 16 and the air admittance valve 30, the relief vent 16 and the air admittance valve 30 are connected to the same connector pipe 106 on the branch piping 14 using a Y-connector (Figure 1).

[0027] In use, as waste flows down the stack 12, gases can become trapped in the stack 12. These gases escape from the stack 12 into the branch piping 14 which creates positive

pressure in the branch pipings 14. Upon the creation of positive pressure in a branch piping 14, the relief vent 16 connected to the branch piping 14 opens automatically to let the trapped gas escape. Once the pressure reduced to below atmospheric pressure relief vent 16 closes automatically. By closing automatically upon the equalization of pressure within the branch piping 14, the relief vent 16 prevents sewer gases from exiting the drainage system 10 through the relief vent 16. In one (1) embodiment, the relief vent 16 closes before liquid in the branch piping 14 can enter the relief vent 16. Thus, water or waste does not exit the drainage system 10 through the relief vent 16. The relief vent 16 is positioned before the first trap 104 of the branch piping 14 to prevent the positive pressure from blowing out any of the traps 104 of the branch piping 14. In the embodiment which also includes an air admittance valve 30, the pressure in the branch piping 14 will always be equalized either by the opening of the relief vent 16 to reduce positive pressure to allow gases out of the drainage system 10 or by opening the air admittance valve 30 to reduce negative pressure and to allow air into the drainage system 10.

[0028] It is intended that the foregoing description be only illustrative of the present invention and that the present invention be limited only by the hereinafter appended claims.